

TRANSLATOR'S DECLARATION

I, Takeshi ANDO, 2nd Flr. A2 Bldg. 45-4, Higashi-Ikebukuro, 1-chome, Toshima-ku, Tokyo Japan, do hereby declare that I am the translator of the attached translation of a certified copy of Japanese Patent Application

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and swear that the following is true translation of the certified copy to the best of my knowledge and belief.



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[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION] BUTT WELDING APPARATUS

[WHAT IS CLAIMED IS]

[CLAIM 1] A butt welding apparatus having a pair of two electrode members disposed on a surface side and a back surface side of two plate members to be welded whose end faces are butted to each other, each electrode member having a thickness size bridging across the plate member to be welded, and the electrode members being provided with pressing portions for pressing one plate member to be welded of the two plate members to be welded in a thickness direction of the one plate member to be welded to swell and deform an end face of the one plate member to be welded which faces the other plate member to be welded toward the other plate member to be welded by the pressing, for melting and joining a butt portion of the two plate members to be welded due to electric resistance heat generated by supplying current between the pair of electrode members, wherein

at least one electrode member of the pair of electrode members is provided on an outer surface thereof which faces the two plate members to be welded with a retreating-shaped portion formed so as to gradually retreat from the one plate member to be welded of the two plate members to be welded according to extension from an intermediate portion, in a thickness direction, of the at least one electrode member of the pair of electrode members along the one plate member to be welded of the two plate members to be welded.

[CLAIM 2] A butt welding apparatus according to claim 1, wherein

the retreating-shaped portion is provided on the outer face of one electrode member of the pair of electrode members,

the retreating-shaped portion is defined as a first retreating-shaped portion on the one electrode member,

a second retreating-shaped portion formed so as to gradually retreats from the other plate member to be welded of the two plate members to be welded according to extension from the intermediate portion, in the thickness direction, of the one electrode member along the other plate member to be welded of the two plate members to be welded is provided on the outer face of the one electrode member, and

the second retreating-shaped portion on the one electrode member and the first retreating-shaped portion on the one electrode member are connected to each other.

[CLAIM 3] A butt welding apparatus according to claim 1, wherein

the retreating-shaped portion is provided on the outer face of one electrode member of the pair of electrode members,

a projecting continuous portion having a projecting amount equal to the maximum projecting amount of the retreating-shaped portion which projects toward the two plate members to be welded is provided on the outer face of the one electrode member, and

the projecting continuous portion connecting to the retreating-shaped portion is constituted such that the equal projecting amount is continuous from the intermediate portion, in the thickness direction, of the one electrode member to extend along the other plate member to be welded of the two plate members to be welded.

[CLAIM 4] A butt welding apparatus according to claim 2 or 3, wherein the outer face of the other electrode member of the pair of electrode members is formed as a flat shaped portion having an equal projecting amount toward the two plate members to be welded which is continuous along a thickness direction of the other electrode member.

[CLAIM 5] A butt welding apparatus according to claim 2 or 3, wherein the other electrode member of the pair of electrode members is provided on an outer face thereof with a retreating-shaped portion formed so as to gradually retreat from one plate member to be welded of the two one plate members to be welded according to extension

from an intermediate portion, in a thickness direction, of the other electrode member along the one plate member to be welded,

the retreating-shaped portion is defined as a first retreating-shaped portion on the other electrode member,

a second retreating-shaped portion formed so as to gradually retreat from the one plate member to be welded of the two plate members to be welded according to extension from the intermediate portion, in the thickness direction, of the other electrode member along the other plate member to be welded is provided on the outer face of the other electrode member, and

the second retreating-shaped portion on the other electrode member and the first retreating-shaped portion on the first electrode member are connected to each other.

[CLAIM 6] A butt welding apparatus according to claim 2 or 3, wherein the other electrode member of the pair of electrode members is provided on an outer face thereof with a retreating-shaped portion formed so as to gradually retreat from one plate member to be welded of the two one plate members to be welded according to extension from an intermediate portion, in a thickness direction, of the other electrode member along the one plate member to be welded,

a projecting continuous portion having a projecting amount equal to the maximum projecting amount of the retreating-shaped portion of the other electrode member toward the two plate members to be welded is provided on the outer face of the other electrode member, and

the projecting continuous portion connecting to the retreating-shaped portion of the other electrode member is constituted such that the equal projecting amount is continuous from the intermediate portion, in the thickness direction, of the other electrode member to extend along the other plate member to be welded of the two plate members to be welded.

[CLAIM 7] A butt welding apparatus according to any one of claims 1 to 6, wherein the pair of the electrode members are electrode rollers which roll relative to the two plate members to be welded.

[CLAIM 8] A butt welding apparatus according to any one of claims 1 to 6, wherein the pair of electrode members have length sizes extending along the butt portion of the two plate members to be welded, and are constituted as block electrodes for acting a press load on these plate members to be welded.

[CLAIM 9] A butt welding apparatus according to claim 8, wherein the butt portion of the two plate members to be welded extends non-linearly and the pair of block electrodes have extending shapes corresponding to the butt portion.

[CLAIM 10] A butt welding apparatus according to claim 8 or 9, wherein the pair of block electrodes have shapes corresponding to a shape of the two plate members to be welded which have been press-formed, and butt welding of these plate members to be welded which have been press-formed is conducted by the pair of block electrodes.

[CLAIM 11] A butt welding apparatus according to claim 8 or 9, wherein the pair of block electrodes are arranged in respective press dies for press-forming the two plate members to be welded, and when the two plate members to be welded is press-formed in the press dies, butt welding of these plate members to be welded is conducted by the pair of block electrodes.

[CLAIM 12] A butt welding apparatus according to any one of claims 1 to 6, wherein the pair of electrode members are spot electrodes for spot-welding the two plate members to be welded.

[CLAIM 13] A butt welding apparatus according to claim 12, wherein the pair of spot electrodes are for butt-welding the two plate members to be welded which have been subjected to a press forming.

[CLAIM 14] A butt welding apparatus according to claim 12, wherein the pair of spot

electrodes are arranged in press dies for press-forming the two plate members to be welded, and when the two plate members to be welded are press-formed by the press dies, the butt welding of these plate members to be welded is conducted by the pair of spot electrodes.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field to which the invention belongs]

The present invention relates to a butt welding apparatus for melting and joining a butt portion of two plate members to be welded whose end faces are butted to each other with electric resistance heat generated by supplying current between a pair of two electrode members.

[0002]

[Background Art]

The present applicant has proposed a butt welding apparatus where a pair of two electrode members are arranged at a butt portion formed by butting end faces of two plate members to be welded to each other and the butt portion is melted and joined with electric resistance heat generated by supplying current between the electrode members in the following Patent Literature 1.

[0003]

The butt welding apparatus is a butt welding apparatus having a pair of two electrode members disposed on a surface side and a back surface side of two plate members to be welded whose end faces are butted to each other, each of the electrode members having such a thickness as to bridge across the these plate members to be welded, for melting the butt portion of the two plate members to be welded with electric resistance heat generated by supplying current between the electrode members to join the plate members to be welded, where press portions are provided in the pair of

electrode members, for pressing one plate member to be welded of the two plate members to be welded in the thickness direction thereof to swell and deform the end face of the one plate member to be welded, which faces the other plate member to be welded, toward the other plate member to be welded according to this pressing.

[0004]

According to this butt welding apparatus, one plate member of two plate members is pressed by the pressing portions of the pair of electrode members at a starting time of a butt welding work. Thereby, the end face of the one plate member which faces the other plate member swells and deforms toward the other plate member to come in contact with the end face of the other plate member securely. Therefore, even if the end faces of these respective plate members are not subjected to polishing work or the like for finishing prior to a butt welding work, an electrically conductive state between the end faces of the plate members can be ensured and a nugget bridging across these end faces is securely formed, so that a large joining strength can be achieved.

[0005]

Further, in a conventional common butt welding where a pair of two electrode members are used, foils comprising metal thin films bridging across a butt portion of plate members are placed on surface and back surface of these plate members, and a pair of electrode members are brought in pressure contact with two plate members via these foils so that butt welding of the two plate members is performed while preventing melting pieces generated due to electric resistance heat from leaking externally. However, according to the butt welding apparatus which has been proposed by the present applicant, such foils are made unnecessary.

[0006]

Furthermore, according to the butt welding apparatus which has been proposed

by the present applicant, when two plate members are different in thickness or when they have the same thickness, at least one electrode member of the pair of electrode members is formed in a shape of a projecting stepped portion so that one plate member of the two plate members can be pressed toward a thickness direction of the plate member. As a result, an end face of the one plate member is caused to swell and deform toward the other plate member and, therefore, the end faces of the plate members can be brought in contact with each other.

[0007]

[Patent Literature 1]

JP2002-291826A (Scope of Claims, and Fig. 2 to Fig. 5)

[0008]

[Problem to be solved by the Invention]

According to the butting welding apparatus which has been proposed by the present applicant, however, the projecting amount of the projecting stepped portion provided on the at least one electrode member of the pair of electrode members is set according to the thickness sizes of two plate members to be butt-welded. Therefore, when butt welding works are performed on respective two plate members having different differences in thickness or when butt welding work is performed on two plate members having the same thickness size, electrode members which are respectively provided with projection stepped portions having different projecting amounts are eventually used. Accordingly, various electrode members provided with projecting stepped portions having different projecting amounts must be prepared in order to allow plate members having various thickness sizes to be butt-welded.

[0009]

An object of the present invention is to provide a butt welding apparatus where but welding can be implemented regarding plate members to be welded having various

thickness sizes by electrode members made common.

[0010]

[Means for solving the Problem]

A butt welding apparatus according to the present invention is a butt welding apparatus having a pair of two electrode members disposed on a surface side and a back surface side of two plate members to be welded whose end faces are butted to each other, each electrode member having a thickness size bridging across these plate members, and the electrode members being provided with pressing portions for pressing one plate member to be welded of the two plate members to be welded in a thickness direction of the one plate member to be welded to swell and deform an end face of the one plate member to be welded which faces the other plate member to be welded toward the other plate member to be welded by the pressing, for melting and joining a butt portion of the two plate members to be welded due to electric resistance heat generated by supplying current between the pair of electrode members, wherein at least one electrode member of the pair of electrode members is provided on an outer surface thereof which faces the two plate members to be welded with a retreating-shaped portion formed so as to gradually retreat from one plate member to be welded of the two plate members to be welded according to extension from an intermediate portion, in a thickness direction, of the at least one electrode member of the pair of electrode members along the one plate member to be welded of the two plate members to be welded.

[0011]

In the butt welding apparatus, at least one electrode member of a pair of electrode members is provided on its outer face with the retreating-shaped portion formed so as to gradually retreat from one plate member to be welded of two plate members according to extension from an intermediate portion, in a thickness direction,

of the at least one electrode member along the one plate member. Therefore, when a butt welding work of two plate members is started, one plate member of the two plate members is pressed by a proper portion of the retreating-shaped portion corresponding to a difference in thickness between the two plate members, and when the two plate members have the same thickness size, the one plate member is pressed by a portion of the retreating-shaped portion which projects toward the plate member in the maximum amount.

[0012]

Thereby, the portion of the retreated-shaped portion which presses the one plate member of the two plate members serves as the pressing portion of the electrode member, so that an end face of the one plate member which faces the other plate member can be swelled and deformed toward the other plate member.

[0013]

When butt welding is performed on other plate members having a different difference therebetween, a position of these plate members to be set to the pair of electrode members is changed so that the butt welding work is performed utilizing a portion of the retreating-shaped portion different from a portion thereof used for the previous butt welding as the pressing portion.

[0014]

Thereby, regarding plate members with different thickness sizes, butt welding works therefor can be performed by using the same electrode member provided on an outer face thereof with the retreating-shaped portion, so that a common use of the electrode member can be realized.

[0015]

Further, since it is unnecessary to form, on an electrode member, a projecting stepped portion having a projecting amount corresponding to a difference in thickness

between two plate members or the like, it is made unnecessary to conduct a maintenance work on the projecting amount of the projecting stepped portion on the electrode member, so that workability on the electrode member can be improved.

[0016]

In case that the retreating-shaped portion is provided on one electrode member of a pair of electrode members, the shape of one electrode member can take one of the following aspects.

[0017]

In a first aspect, the retreating-shaped portion is defined as a first retreating-shaped portion on the one electrode member provided with the retreating-shaped portion, a second retreating-shaped portion formed so as to gradually retreat from the other plate member of the two plate members according to extension from an intermediate portion, in a thickness direction, of the one electrode member along the other plate member is provided on the outer face of the one electrode member, and the second retreating-shaped portion and the first retreating-shaped portion are connected to each other.

[0018]

In a second aspect, a projecting continuous portion having a projecting amount equal to the maximum projecting amount of the retreating-shaped portion which projects toward the two plate members is provided on the outer face of the one electrode member provided with the retreating-shaped portion, and the projecting continuous portion connected to the retreating-shaped portion is defined as a portion where the equal projecting amount is continuous from the intermediate portion, in the thickness direction, of the one electrode member along the other plate member of the two plate members.

[0019]

Further, in case that the retreating-shaped portion is provided on one electrode

member of a pair of electrode members, the shape of the other electrode member can take one of the following shapes.

[0020]

In a first aspect, the outer face of the other electrode member is defined as a flat-shaped portion having an equal projecting amount toward the two plate members continuous along a thickness direction of the other electrode member.

[0021]

In a second aspect, a retreating-shaped portion formed so as to gradually retreat from one plate member of the two plate members according to extension from an intermediate portion, in a thickness direction, of the other electrode member along the one plate member is provided on an outer face of the other electrode member, the retreating-shaped portion is defined as a first retreating-shaped portion on the other electrode member, a second retreating-shaped portion formed so as to gradually retreat from the other plate member of the two plate members according to extension from an intermediate portion, in the thickness direction, of the other electrode member along the other plate member is provided on the outer face of the other electrode member, and the second retreating-shaped portion and the first retreating-shaped portion are connected to each other.

[0022]

In a third aspect, a retreating-shaped portion formed so as to gradually retreat from one plate member of the two plate members according to extension from an intermediate portion, in a thickness direction, of the other electrode member along the one plate member is provided on an outer face of the other electrode member, a projecting continuous portion having a projecting amount equal to the maximum projecting amount of the retreating-shaped portion which projects toward the two plate members regarding the retreating-shaped portion of the other electrode member is

provided on the outer face of the other electrode member, and the projecting continuous portion connected to the retreating-shaped portion of the other electrode member is defined as a portion where the equal projecting amount is continuous from the intermediate portion, in the thickness direction, of the other electrode member along the other plate member of the two plate members.

[0023]

In the above, each retreating-shaped portion provided on one electrode member or both electrode members of a pair of electrode members may take any shape where it retreats from a plate member gradually. The retreating-shaped portion may take, for example, an oval shape, a parabolic shape, an arc shape, or a linear shape, and it also may take a shape obtained by combining at least two of these shapes.

[0024]

Further, in the present invention, the pair of electrode members may be a pair of electrode rollers which roll on two plate members, or they may be a pair of block electrodes which have such length sizes as to extend along a butt portion of two plate members and apply press load on these plate members.

[0025]

When the pair of electrode members are constituted of the latter pair of block electrodes, a butt welding work on two plate members can be finished by once pressing a butt portion of the plate members with the respective block electrodes, so that reduction in butt welding work time or a high efficiency on many butt welding works can be achieved.

[0026]

When the pair of electrode members are constituted of a pair of block electrodes, a butt portion of two plate members may be a linearly extending one, or a non-linearly extending one. In case that the butt portion is the non-linearly extending

portion, the respective electrode members may be constituted so as to have non-linearly extending portions corresponding to the butt portion. Here, the term “non-linearly” includes a case where straight lines are curved at an intermediate portion to be connected, a case where a curve including an arc or a straight line and a curve are connected, and a case where a curve and a curve are connected.

[0027]

In case that the pair of electrode members are constituted of the pair of block electrodes, two plate members before being subjected to a press forming may be butt-welded by these block electrodes, or the respective block electrodes may be formed so as to have shapes corresponding to shapes of two plate members which have been press-formed so that a butt welding work of the press-formed plate members may be performed by these block electrodes.

[0028]

In addition, in case that the pair of electrode members are constituted of a pair of block electrodes, the respective block electrodes are disposed in press dies for press-forming two plate members, and when two plate members to be welded are press-formed by these press dies, a butting welding work of these plate members may be performed by the pair of block electrodes.

[0029]

In the present invention, also, the pair of electrode members may be a pair of spot electrodes for performing spot welding on two plate members. That is, the present invention is applicable to a spot welding apparatus. Further, the pair of spot electrodes may be for performing butt welding on two plate members before they are press-formed or they may be for performing butt welding on two plate members which have been press-formed like the above-described block electrodes. Furthermore, the respective spot electrodes may be disposed in press dies for press-forming two plate

members, and when two plate members are press-formed by these press dies, butting welding of these plate members may be performed by the pair of spot electrodes.

[0030]

In the present invention explained above, the number of two plate members to be butt-welded is the number of plate members arranged when they are butt-welded to each other. Accordingly, such a case that a plurality of plate members are arranged along an end face of one plate member and these plate members are butt-welded is also included in the present invention.

[0031]

In the present invention, a positional relationship between a pair of electrode members and two plate members may be a positional relationship where two electrode members are disposed on an upper side and a lower side of two plate members whose surface and back surface directions correspond to a vertical direction or it may be a positional relationship where two electrode members are disposed on a left side and a right side of two plate members whose surface and back surface directions correspond to left and right directions.

[0032]

Further, the butt welding apparatus according to the present invention are applied for butt-welding any plate members made from any material melted due to electrical resistance heat. The material may be, for example, steel, stainless steel, aluminum, titanium, magnesium, or alloy of various materials. In addition, materials of two plate members to be butt-welded may be the same or different from each other.

[0033]

[EMBODIMENTS OF THE INVENTION]

The present invention will be described below with reference to the accompanying drawings. Fig. 1 is a perspective view schematically showing a butt

welding apparatus according to an embodiment of the present invention. Two plate members to be welded 31, 32 each composed of a steel plate or another metal plate are butted and fixedly set to a work table 61 of a welding apparatus by fixing tools 62, 63. One of the plate members is a thick plate member 31 having a large thickness size and the other plate member is a thin plate member 32 having a small thickness size.

[0034]

Fig. 2 shows a butt portion 71 of an end face 31A of the thick plate member 31 and an end face 32A of the thin plate member 32 in an enlarged manner. The butt portion 71 is coincident with the position of an elongated opening portion 61A of the work table 61 shown in Fig. 1, and two electrode rollers 1, 2 serving as a pair of two electrode members for butt-welding the butt portion 71 with electric resistance heat are disposed above and below the opening portion 61A, namely, on surface and back surface sides of the two plate members 31, 32. The upper side electrode roller 1 of the electrode rollers 1, 2, each having a thickness size bridging across the butt portion 71, moves up and down with respect to the work table 61, the lower side electrode roller 2 moves up and down at a position where it is inserted into the opening portion 61A, and these electrode rollers 1, 2 abut on the plate members 31, 32 to perform butt welding thereto. Further, the work table 61 moves to a lengthwise direction of the butt portion 71 during welding work, so that the butt portion 71 is melt and joined over its entire length with electric resistance heat in the plate members 31, 32 by the electrode rollers 1, 2 rolling while being supplied with power during the welding.

[0035]

Incidentally, though is not illustrated, means for supplying non-oxidizing gas such as argon gas, nitrogen gas or the like to the butt portion 71 during welding work is provided in the welding apparatus, where the butt portion 71 is welded while being supplied with non-oxidizing gas.

[0036]

As shown in Fig. 2, the thick plate member 31 and the thin plate member 32 are butted to each other in a state that one of one surfaces of both surfaces of the thick plate member 31 and both surfaces of the thin plate member 32 are shifted from each other so as to form a step difference and in a state that the others have been coincident with each other so as not to form any step difference. Specifically, the thick plate member 31 and the thin plate member 32 are butted on each other in a state that the surfaces of the surfaces and the back surfaces of the thick plate member 31 and the thin plate member 32 have been shifted so as to form a step difference and in the state that the back surfaces thereof are coincident with each other so as not to form any step difference.

[0037]

As shown in Fig. 2, an outer surface of the electrode roller 1 of the two electrode rollers 1, 2 which is disposed on the upper side where the step difference exists between the thick plate member 31 and the thin plate member 32, the outer surface facing the plate members 31, 32, in other word, an outer peripheral surface of the electrode roller 1 is formed in an oval shape projecting toward the plate members 31, 32 in a curved manner. For this reason, a first retreating-shaped portion 1A formed so as to gradually retreat from the thick plate member 31 according to extension from a central portion, in a thickness direction, of the electrode roller 1 along the thick plate member 31 is provided on the outer face of the electrode roller 1. Further, a second retreating-shaped portion 1B formed so as to gradually retreat from the thin plate member 32 according to extension from the central portion, in the thickness direction, of the electrode roller 1 along the thin plate member 32 is provided on the outer face of the electrode roller 1. The first and second retreating-shaped portions 1A and 1B are smoothly connected to each other at the central portion, in the thickness direction, of the

electrode roller 1.

[0038]

On the other hand, an outer surface of the electrode roller 2 of the two electrode rollers 1, 2 which is disposed on the lower side where no step difference exists between the thick plate member 31 and the thin plate member 32, the outer surface facing the plate members 31, 32, is formed as a flat-shaped portion 2A whose projecting amount toward the plate members 31, 32 is continuous along the thickness direction of the electrode roller 2, and an outer peripheral face of the electrode roller 2 is formed with the flat-shaped portion 2A.

[0039]

Fig. 2 to Fig. 4 are views showing steps in a butt welding work performed according to its order by a combination of the above-described electrode rollers 1, 2 and the plate members 31, 32.

[0040]

As shown in Fig. 2, the thick plate member 31 and the thin plate member 32 are fixedly set to the work table 61 shown in Fig. 1 in a state that the butt portion 71 of these plate members 31, 32 has been offset from the central portions of the electrode rollers 1, 2 in the thickness direction of the electrode rollers toward the first retreating-shaped portion 1A of the electrode roller 1 by an amount corresponding to L1. For this reason, the central portion, in the thickness direction, of the electrode roller 1 which constitutes the most projected portion on the outer face of the electrode roller 1 toward the thin plate member 32 projects toward the thin plate member 32 from the portion of the first retreating-shaped portion 1A corresponding to the position of the butt portion 71 by a projecting amount H1 corresponding to the offset amount L1.

[0041]

After the plate members 31, 32 are fixedly set to the work table 61, the

electrode rollers 1, 2 press the butt portion 71, so that butt welding of the plate members 31, 32 is started between the electrode rollers 1, 2 being supplied with power by this time.

[0042]

As shown in Fig. 2, the butt welding is started from such a step that the first retreating-shaped portion 1A of the electrode roller 1 presses an upper corner portion of the end face 31A of the thick plate member 31 downwardly and a portion of the flat-shaped portion 2A of the electrode roller 2 in contact with the thick plate member 31 receives the pressing force. For this reason, the first retreating-shaped portion 1A on the electrode roller 1 and the flat-shaped portion 2A in contact with the thick plate member 31 on the electrode roller 2 serve as pressing portions for pressing the thick plate member 31, respectively.

[0043]

As shown in Fig. 3, the end face 31A of the thick plate member 31 swells and deforms toward the thin plate member 32 due to the pressing force according to advance of the pressing, so that the end face 31A comes in contact with the end face 32A of the thin plate member 32. For this reason, even if the end face 31A of the thick plate member 31 and the end face 32A of the thin plate member 32 prior to butt-welding have surfaces as being subjected to shearing work for producing the thick plate member 31 and the thin plate member 32 from blank members and they are faces which have not been subjected to finishing work such as polishing work, these end faces 31A and 32A securely come in contact with each other during the butt welding.

[0044]

Further, when the electrode roller 1 presses and deforms the upper corner portion of the end face 31A of the thick plate member 31 up to a state shown in Fig. 3, a nugget 48 obtained by melting of some material in the thick plate member 31 due to

electric resistance heat generated by current conduction is produced inside the thick plate member 31 where a current route has been formed because the thick plate member 31 is in contact with both the electrode rollers 1 and 2.

[0045]

When pressing on the thick plate member 31 by the electrode rollers 1, 2 further progresses, as shown in Fig. 4, the central portion, in the thickness direction thereof, of the electrode roller 1 having the projecting amount H1 from the butt portion 71 comes in contact with the thin plate member 32, and the second retreating-shaped portion 1B of the electrode roller 1 also comes in contact with the thin plate member 32, so that the thin plate member 32 is pressed by both the electrode rollers 1 and 2. At this time, a current route has been also formed inside the thin plate member 32 brought into contact with both the electrode rollers 1 and 2, and a current route passing through the butt portion 71 of the end faces 31A and 32A of the plate members 31, 32 in contact with each other is also formed. For this reason, the nugget 48 is also produced inside the thin plate member 32 and it has such a size that it bridges across the end faces 31A, 32A of the plate members 31, 32.

[0046]

The above is directed to explanation about the same sectional position of the two plate members 31, 32 to be butt-welded to each other, but the butt welding progressing from the state shown in Fig. 2 to the state shown in Fig. 4 by the pair of two electrode rollers 1, 2 is conducted over the entire length of the butt portion 71 according to movement of the work table 50 shown in Fig. 1 and rolling of the electrode rollers 1, 2 relative to the plate members 31, 32 according to the movement.

[0047]

Further, the nugget 48 bridging across both the plate members 31, 32 over the butt portion 71 is produced so that a butt welding strength of these plate members 31, 32

becomes large.

[0048]

Fig. 5 shows a case that butt welding of the thick plate member 31 and a thin plate member 33 thinner than the plate member 32 is conducted using the same electrode rollers 1, 2 as shown in Fig. 2. The butt welding is also conducted in a state that surfaces of the thick plate member 31 and the thin plate member 33 are shifted from each other to form a step difference and in a state that back surfaces thereof are coincident with each other so as not to form any step difference. In the butt welding, however, the position of the butt portion 72 of the thick plate member 31 and the thin plate member 33 relative to the central portions of the electrode rollers 1, 2 in the thickness direction thereof is also offset toward the first retreating-shaped portion 1A of the electrode roller 1, but an offset amount L2 thereof is larger than the offset amount L1 shown in Fig. 2.

[0049]

This butt welding is also started from such a step that the first retreating-shaped portion 1A of the electrode roller 1 presses an upper corner portion of the end face 31A of thick plate member 31 downwardly, and a portion of the flat-shaped portion 2A of the electrode roller 2 in contact with the thick plate member 31 receives the pressing force. Thereafter, states similar to those shown in Fig. 3 and Fig. 4 occur, where the swelled and deformed end face 31A of the thick plate member 31 comes in contact with an end face 33A of the thin plate member 33 and the central portion, in the thickness direction, of the electrode roller 1 having a large projecting amount H2 toward the thin plate member 33 due to the offset amount L2 starts pressing the thin plate member 33 so that the second retreating-shaped portion 1B of the electrode roller 1 also starts pressing the thin plate member 33. Thereby, a nugget which bridges across a butt portion 72 can be formed inside both the plate members 31 and 33.

[0050]

Fig. 6 shows a case that butt welding of two plate members 34, 35 having the same thickness size is conducted using the same electrode rollers 1, 2 as shown in Fig. 2. The butt welding is conducted in a state that a surface and a back surface of the plate member 34 have been coincident with those of the plate member 35 so as not to form any step difference. The butt welding is conducted in such a state that the offset of a butt portion 73 of the two plate members 34, 35 relative to the central portions, in the thickness direction, of the electrode rollers 1, 2 has been offset toward one plate member, in the illustrated example, toward the second retreating-shaped portion 1B of the electrode roller 1 in the contrary direction to the cases shown in Fig. 2 and Fig. 5. The offset amount is shown with L3 in Fig. 6.

[0051]

The butt welding in the case shown in Fig. 6 is started from such a step that the central portion, in a thickness direction, of the electrode roller 1 presses a surface of the plate member 34 in the vicinity of an end face 34A thereof downwardly and the portion of the flat-shaped portion 2A of the electrode roller 2 in contact with the plate member 34 receives the pressing force. For this reason, in the electrode roller 1, the central portion of the electrode roller 1 in the thickness direction, in other words, an end portion of the first retreating-shaped portion 1A connected to the second retreating-shaped portion 1B serves as a pressing portion which presses one plate member 34 of the two plate members 34, 35 at a starting time of butt welding. In the electrode roller 2, the portion of the flat-shaped portion 2A in contact with the plate member 34 serves as a pressing portion which presses the plate member 34.

[0052]

Thereafter, like the states shown in Fig. 3 and Fig. 4, the swelled and deformed end face 34A of the plate member 34 comes in contact with the end face 35A of the

plate member 35, and then the second retreating-shaped portion 1B of the electrode roller 1 presses the plate member 35 due to an offset amount L3. Thereby, a nugget which bridges across the end faces 34A, 35A is formed inside the plate members 34 and 35.

[0053]

As apparent from the above explanation, according to this embodiment, the electrode roller 1 of the pair of two electrode rollers 1, 2 is provided with the retreating-shaped portion 1A which gradually retreats from one plate member of two plate members to be butt-welded according to extension from the central portion, in the thickness direction, of the electrode roller 1 along the one plate member so that the two plate members to be butt-welded can be butt-welded by using the same electrode rollers 1, 2 even in case of the thick plate member 31 and the thin plate member 32, which is shown in Fig. 2, even in case that the thick plate member 31 and the thinner plate member 33, which is shown in Fig. 5, or in case of the plate members 34, 35 having the same thickness size, which is shown in Fig. 6. Therefore, the electrode rollers 1, 2 can be used commonly so that it is made unnecessary to prepare various electrode rollers corresponding to thickness sizes of plate members or the like.

[0054]

According to this embodiment, since it is not that electrode rollers having projecting stepped portions corresponding to a difference in thickness between plate members are used, it is unnecessary to conduct maintenance work on the projecting amounts of the projecting stepped portions on the electrode members, so that workability on the electrode members is made excellent.

[0055]

Fig. 7 to Fig. 9 show a case that the same lower side electrode roller 2 as shown in Fig. 2 is used as a lower side roller and an electrode roller 3 different from the

upper side electrode roller 1 shown in Fig. 2 is used as an upper side electrode roller.

[0056]

Fig. 7 shows a case that the same plate members 31, 32 as shown in Fig. 2 are used as two plate members and a butting state of these plate members 31, 32 is set to the same state as shown in Fig. 2. Further, Fig. 8 shows a case that the same plate members 31, 33 as shown in Fig. 5 are used as two plate members and a butting state of these plate members 31, 33 is set to the same state shown in Fig. 5. Furthermore, Fig. 9 shows a case that the same plate members 34, 35 as shown in Fig. 6 are used as two plate members and a butting state of these plate members 34, 35 is set to the same state as shown in Fig. 6.

[0057]

An upper side roller 3 shown in Fig. 7 to Fig. 9 is provided on its outer face with a retreating-shaped portion 3A formed so as to gradually retreat from the plate member 31, 31 or 34 according to extension from a central portion, in a thickness direction, of the electrode roller 3 along the right side plate member 31, 31 or 34 of the two plate members. Further, the electrode roller 3 is provided on the outer face with a projecting continuous portion 3B having a projecting amount equal to the maximum projecting amount of the retreating-shaped portion 3A which projects toward the two plate members 31 and 32, 31 and 33, or 34 and 35, that is, having a projecting amount equal to the projecting amount of the central portion, in the thickness direction, of the electrode roller 3. The projecting continuous portion 3B connected with the retreating-shaped portion 3A constitutes a portion where the projecting amount equal to the maximum projecting amount of the retreating-shaped portion 3A is continuous so as to extend from the central portion, in the thickness direction, of the electrode roller 3 along the plate member 32, 33 or 35.

[0058]

In Fig. 7 and Fig. 8, an offset of the butt portion 71 or 72 of the two plate members 31 and 32, or 31 and 33 relative to the electrode rollers 2, 3 is set in a manner similar to the cases shown in Fig. 2 and Fig. 5. On the other hand, in Fig. 9, an offset of the butt portion 73 of the two plate members 34, 35 relative to the electrode rollers 2, 3 is set in a direction reverse to the direction shown in Fig. 6.

[0059]

In these Fig. 7 to Fig. 9, a portion of the retreating-shaped portion 3A including the central portion of the upper side electrode roller 3 in the thickness direction thereof first presses one plate member 31, 31 or 35 of the two plate members 31 and 32, 31 and 33 or 34 and 35. In Fig. 9, the projecting continuous portion 3B of the electrode roller 3 first presses the one plate member 35, too. Thereby, the end face 31A, 31A or 35A of the plate member 31, 31 or 35 swells and deforms to come in contact with the end face 32A, 33A or 34A of the plate member 32, 33 or 34. Next, in Fig. 7 and Fig. 8, the central portion, in the thickness direction, of the electrode roller 3 and the projecting continuous portion 3B press the plate member 32 or 33, and in Fig. 9, the retreating-shaped portion 3A of the electrode roller 3 presses the plate member 34. Thereby, a nugget which bridges across the end faces 31A and 32A, 31A and 33A, or 34A and 35A is formed in a manner similar to the cases shown in Fig. 2, Fig. 5 and Fig. 6.

[0060]

Two plate members comprising one of the various combinations shown in Fig. 7 to Fig. 9 can be butt-welded by the combination of the same electrode rollers 2 and 3.

[0061]

In Fig. 10 to Fig. 12, an upper side electrode roller of a pair of two electrode rollers is the same upper side electrode roller 1 as shown in Fig. 2, and a lower side electrode roller is an electrode roller 4 formed so as to have the same outer face as that of the upper side electrode roller 1. Accordingly, the outer face of the lower side

electrode roller 4 has an oval shape projecting toward two plate members to be butt-welded in a curved manner, and the outer face comprises a first retreating-shaped portion 4A and a second retreating-shaped portion 4B which are smoothly connected to each other at a central portion, in a thickness direction, of the electrode roller 4.

[0062]

Two plate members shown in Fig. 10 are a thick plate member 36 having a large thickness size and a thin plate member 37 having a small thickness size. These plate members 36, 37 are fixedly set to the work table 61 in a state that a surface and a back surface of the thick plate member 36 are shifted from a surface and a back surface of the thin plate member 37 and the thin plate member 37 is positioned within the thickness of the thick plate member 36. The fixedly setting is performed such that a butt portion 74 of the two plate members 36, 37 is offset from the central portion in a thickness direction of the electrode rollers 1, 4 toward the first retreating-shaped portions 1A, 4A of these electrode rollers 1, 4 by an amount L4.

[0063]

Two plate members shown in Fig. 11 are the thick plate member 36 and a thin plate member 38 thinner than the thin plate member 37. These plate members 36, 38 are also fixedly set to the work table 61 in such a state that a surface and a back surface of the thick plate member 36 are shifted from a surface and a back surface of the thin plate member 38 and the thin plate member 38 is positioned within the thickness of the thick plate member 36. The fixedly setting is performed such that a butt portion 75 of the two plate members 36, 38 is offset from the central portion in a thickness direction of the electrode rollers 1, 4 toward the first retreating-shaped portions 1A, 4A of these electrode rollers 1, 4 by an amount L5. The offset amount L5 is larger than the offset amount L4 shown in Fig. 10.

[0064]

Two plate members shown in Fig. 12 are plate members 39, 40 having the same thickness size. Butting between end faces 39A, 40A of the plate members 39, 40 is performed in a state that a surface and a back surface of the plate member 39 are coincident with those of the plate member 40 without any step difference. Further, a butt portion 76 of the plate members 39, 40 is offset from the central portions, in thickness directions, of the electrode rollers 1, 4 toward the second retreating-shaped portions 1B, 4B of the electrode rollers 1, 4 by an amount L6.

[0065]

In Fig. 10 to Fig. 12, one portions of the first retreating-shaped portions 1A, 4A including central portions, in thickness directions, of the upper and lower electrode rollers 1, 4 first press one plate member 36, 36 or 39 of two plate members 36 and 37, 36 and 38, or 39 and 40. Thereby, an end face 36A, 36A or 39A of the plate member 36, 36 or 39 swells and deforms to come in contact with an end face 37A, 38A or 40A of the plate member 37, 38 or 40. Next, in Fig. 10 and Fig. 11, the central portions, in thickness directions, of both the electrode rollers 1, 4 and the second retreating-shaped portions 1B, 4B press the plate member 37 or 38, and in Fig. 12, the second retreating-shaped portions 1B, 4B of both the electrode rollers 1, 4 press the plate member 40. Thereby, a nugget which bridges across the end faces 36A and 37A, 36A and 38A, or 39A and 40A is formed.

[0066]

Then, two plate members constituted with one of various combinations shown in Fig. 10 to Fig. 12 can be butt-welded by the combination of the same electrode rollers 1 and 4.

[0067]

Fig. 13 to Fig. 15 show cases that two plate members 36 and 37, 36 and 38, and 39 and 40 which are respectively the same plate members as shown in Fig. 10 to Fig. 12

are butt-welded by a pair of electrode rollers different from the pair of electrode rollers shown in Fig. 10 to Fig. 12. An upper side electrode roller of these electrode rollers is the same upper side electrode roller 3 as shown in Fig. 7, and a lower side electrode roller is an electrode roller 5 formed so as to have the same outer face as that of the upper side electrode roller 3. Accordingly, the outer face of the lower side electrode roller 5 comprises a retreating-shaped portion 5A and a projecting continuous portion 5B, and the retreating-shaped portion 5A and the projecting continuous portion 5B are smoothly connected to each other at a central portion, in a thickness direction, of the electrode roller 5.

[0068]

Further, in Fig. 13 and Fig. 14, an offset of butt portions 74, 75 of two plate members 36 and 37, or 36 and 38 to central portions, in thickness directions, of a pair of electrode rollers 3, 5 is the same as those in Fig. 10 and Fig. 11. In Fig. 15, however, an offset of a butt portion 76 of two plate members 39 and 40 to central portions, in thickness directions, of the pair of electrode members 3, 5 is reversed to the case shown in Fig. 12, and the butt portion 76 is offset from the central portions, in thickness directions, of the electrode rollers 3, 5 toward the retreating-shaped portions 3A, 5A of the electrode rollers 3, 5 by an amount L6.

[0069]

In these Fig. 13 to Fig. 15, one portions of retreating-shaped portions 3A, 5A including central portions, in thickness directions, of upper and lower electrode rollers 3, 5 first press one plate member 36, 36, or 40 of two plate members 36 and 37, 36 and 38, or 39 and 40, while projecting continuous portions 3B, 5B of the electrode rollers 3, 5 also press the one plate member 40 in Fig. 15. Thereby, an end face 36A, 36A, or 40A of the plate member 36, 36, or 39 swells and deforms to come in contact with an end face 37A, 38A or 39A of the plate member 37, 38, or 39. Next, in Fig. 13 and Fig. 14,

central portions, in thickness directions, of the electrode rollers 3, 5 and projecting continuous portions 3B and 5B thereof press the plate member 37 or 38, while the retreating-shaped portions 3A and 5A press the plate member 39 in Fig. 15. Thereby, a nugget which bridges across the end faces 36A and 37A, 36A and 38A, or 39A and 40A is formed.

[0070]

Then, two plate members 36 and 37, 36 and 38, or 39 and 40 constituted with one of various combinations shown in Fig. 13 to Fig. 15 can be butt-welded by the combination of the electrode rollers 3 and 5 having the same outer shape.

[0071]

Further, butt welding of two plate members 36 and 37, 36 and 38, or 39 and 40 comprising one of various combinations shown in Fig. 13 to Fig. 15 can also be performed by utilizing the electrode roller 1 shown in Fig. 1 or the electrode roller 4 shown in Fig. 10 as one of the pair of electrode rollers and utilizing the electrode roller 3 or 5 shown in Fig. 13 as the other electrode roller.

[0072]

In the embodiments described above, the pair of two electrode members are the electrode rollers, but these electrode members may be replaced with block electrodes installed in a press apparatus.

[0073]

That is, in an embodiment shown in Fig. 16, a block electrode 11 disposed on an upper side corresponding to surface sides of a thick plate member 31 and a thin plate member 32 which are plate members to be welded, and a block electrode 12 disposed on a lower side corresponding to back surfaces of the thick plate member 31 and the thin plate member 32 have thickness sizes bridging across the thick plate member 31 and the thin plate member 32. As shown in Fig. 17 which is a plan view of the apparatus

shown in Fig. 16, the block electrodes 11 and 12 have length sizes extending linearly along a butt portion 71 of the plate members 31 and 32. The block electrode 11 is mounted on an ascending/descending member such as a slide which ascends/descends in the press apparatus, and a block electrode 12 is mounted on an upper face of a board member 91 connected to a stationary member such as bolsters in the press apparatus. The board member 91 is provided with the fixing tools 92, 93 for butting the plate members 31 and 32 in a predetermined positional relationship to fixedly set them on the board member 91.

[0074]

The upper side block electrode 11 descends toward the board member 91 so that the block electrodes 11 and 12 press the butt portion 71. At this time, power is supplied between the block electrodes 11 and 12.

[0075]

Since the plate members 31, 32 shown in Fig. 16 are the same plate members as shown in Fig. 2 to Fig. 4, the block electrodes 11 and 12 have the same sectional shapes as the outer peripheral faces of the electrode rollers 1 and 2 shown in Fig. 2 to Fig. 4. For this reason, butt welding of the thick plate member 31 and the thin plate member 32 performed by descending of the block electrode 11 progresses in the same order as shown in Fig. 2, Fig. 3 and Fig. 4.

[0076]

Further, since the block electrodes 11, 12 have the same sectional shapes as the outer peripheral shapes of the electrode rollers 1 and 2 shown in Fig. 2 to Fig. 4, butt-welding can be performed using these block electrodes 11 and 12 even in case that two plate members to be butt-welded are the plate members 31 and 33 shown in Fig. 5 and even in case that they are the plate members 34 and 35 shown in Fig. 6. Of course, the sectional shapes of the pair of block electrodes may be the same outer peripheral face

shapes as the electrode rollers 2, 3 shown in Fig. 7, the electrode rollers 1, 4 shown in Fig. 10, or the electrode rollers 3, 5 shown in Fig. 13.

[0077]

Fig. 18 shows another embodiment in case where block electrodes are used as a pair of electrode members. Since end faces of two plate members 41, 42 in this embodiment are each formed in a shape of straight lines connected at a right angle, a butt portion 77 obtained by butting these end faces to each other extend in a non-linear manner. Accordingly, block electrodes 13, 14 which are the electrode members for pressing the butt portion 77 also extend non-linearly to correspond to the shape of the butt portion 77.

[0078]

Two plate members 43, 44 according to an embodiment shown in Fig. 19 are preliminarily press-formed in a predetermined shape such as a curved shape before they are butt-welded by block electrodes 15, 16. For this reason, the shapes of the block electrodes 15, 16 correspond to the shapes of the press-formed plate members 43, 44. According to this embodiment, a butt portion 78 of the preliminarily press-formed plate members 43, 44 can be butt-welded by the block electrodes 15, 16.

[0079]

In an embodiment shown in Fig. 20, a pair of block electrodes 17, 18 are disposed in upper and lower press dies 94, 95 for press-forming two plate members 45, 46. For this reason, when the plate members 45, 46 are press-formed in predetermined shapes by the press dies 94, 95, a butt portion 79 of the plate members 45 and 46 is butt-welded by the block electrodes 17, 18. The block electrodes 17, 18 are assembled in the press dies 94, 95 via electrically insulating members 94A, 95A. For this reason, current conduction to the block electrodes 17, 18 for butt-welding the plate members 45, 46 with electric resistance heat is performed in a state where the press-forming dies 94,

95 and the block electrodes 17, 18 have been electrically insulated from each other.

[0080]

According to this embodiment, press forming and butt welding can be simultaneously conducted on the two plate members 45, 46. For this reason, for example, when a constituent member for a vehicle body of a vehicle comprising a tailored blank obtained by joining a plurality of plate members is manufactured, its production efficiency can be improved remarkably.

[0081]

Fig. 21 shows an embodiment where spot electrodes 21, 22 are used as a pair of electrode members. These spot electrodes 21, 22 are disposed at positions corresponding to a butt portion 71 of a thick plate member 31 and a thin plate member 32 which are plate members to be welded, where a pressing force is applied from one spot electrode of these spot electrodes toward the other spot electrode thereof, so that the butt portion 71 is butt-welded. Shapes of portions of the pair of spot electrodes which faces two plate members are formed so as to correspond to the outer shapes of two of the various electrode rollers shown in Fig. 1 to Fig. 12, so that two plate members to be butt-welded can be set to any one of the combinations shown in Fig. 1 to Fig. 12.

[0082]

Further, even when the pair of spot electrodes are used as the pair of electrode members in this manner, two press-formed plate members can be butt-welded by these spot electrodes in the same manner as the case of the block electrodes. Furthermore, the respective spot electrodes are disposed in press dies for press-forming two plate members so that, when the two plate members are press-formed in these press dies, butt welding of these plate members can be performed by one pair of spot electrodes.

[0083]

[ADVANTAGE OF THE INVENTION]

According to the present invention, such an advantage can be obtained that butt welding of plate members to be welded having various thickness sizes can be implemented by electrode members made common.

[BRIEF DESCRIPTION OF DRAWINGS]

[FIG. 1]

Fig. 1 is a perspective view schematically showing a butt welding apparatus according to one embodiment of the present invention when electrode members are electrode rollers;

[FIG. 2]

Fig. 2 is a view showing a butt portion of two plate members in an enlarged manner and showing a state in which butt welding starts in case that a thick plate member and a first thin plate member are butt-welded with a first combination of a pair of two electric rollers;

[FIG. 3]

Fig. 3 is a view showing a state following the start of the butt welding in the case shown in Fig. 2;

[FIG. 4]

Fig. 4 is a view showing a state in which the butt welding has been finished in the case shown in Fig. 2;

[FIG. 5]

Fig. 5 is a view showing a state in which butt welding starts in case that a thin plate member and a second thin plate member are butt-welded with the combination of electrode rollers shown in Fig. 2;

[FIG. 6]

Fig. 6 is a view showing a state in which butt welding starts in case that two

plate members having the same thickness size are butt-welded with the combination of electrode rollers shown in Fig. 2;

[FIG. 7]

Fig. 7 is a view showing a state in which butt welding starts in case that a thick plate member and a first thin plate member are butt-welded with a second combination of a pair of two electric rollers;

[FIG. 8]

Fig. 8 is a view showing a state in which butt welding starts in case that a thin plate member and a second thin plate member are butt-welded by the combination of electrode rollers shown in Fig. 7;

[FIG. 9]

Fig. 9 is a view showing a state in which butt welding starts in case that two plate members having the same thickness size are butt-welded by the combination of the electrode rollers shown in Fig. 7;

[FIG. 10]

Fig. 10 is a view showing a state in which butt welding starts in case that a thick plate member and a third thin plate member are butt-welded with a third combination of a pair of two electric rollers;

[FIG. 11]

Fig. 11 is a view showing a state in which butt welding starts in case that a thick plate member and a fourth thin plate member are butt-welded by the combination of electrode rollers shown in Fig. 10;

[FIG. 12]

Fig. 12 is a view showing a state in which butt welding starts in case that two plate members having the same thickness size are butt-welded by the combination of electrode rollers shown in Fig. 10;

[FIG. 13]

Fig. 13 is a view showing a state in which butt welding starts in case that the thick plate member and the third thin plate member are butt-welded with a fourth combination of a pair of two electric rollers;

[FIG. 14]

Fig. 14 is a view showing a state in which butt welding starts in case that the thick plate member and the fourth thin plate member are butt-welded by the combination of electric rollers shown in Fig. 13;

[FIG. 15]

Fig. 15 is a view showing a state in which butt welding starts in case that two plate members having the same thickness size are butt-welded by the combination of electrode rollers shown in Fig. 13;

[FIG. 16]

Fig. 16 is a perspective view schematically showing a butt welding apparatus of an embodiment where electrode members are block electrodes;

[FIG. 17]

Fig. 17 is a plan view of the butt welding apparatus shown in Fig. 16;

[FIG. 18]

Fig. 18 is a view similar to that in Fig. 17, showing an embodiment where block electrodes are formed to extend non-linearly so as to correspond to a butt portion of two plate members;

[FIG. 19]

Fig. 19 is a vertical sectional view showing an embodiment where press-formed two plate members are butt-welded by block electrodes;

[FIG. 20]

Fig. 20 is a vertical sectional view showing an embodiment where block

electrodes have been disposed in dies for press-forming two plate members;

[FIG. 21]

Fig. 21 is a perspective view schematically showing a butt welding apparatus of an embodiment where electrode members are spot electrodes;

[Explanation of Reference Numerals]

1, 2, 3, 4, 5: electrode roller which is electrode member

1A, 1B, 3A, 4A, 4B, 5A: retreating-shaped portion

2A: flat shaped portion

3B, 5B: projecting continuous portion

11, 12, 13, 14, 15, 16, 17, 18: block electrode which is electrode member

21, 22: spot electrode which is electrode member

31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46: plate member

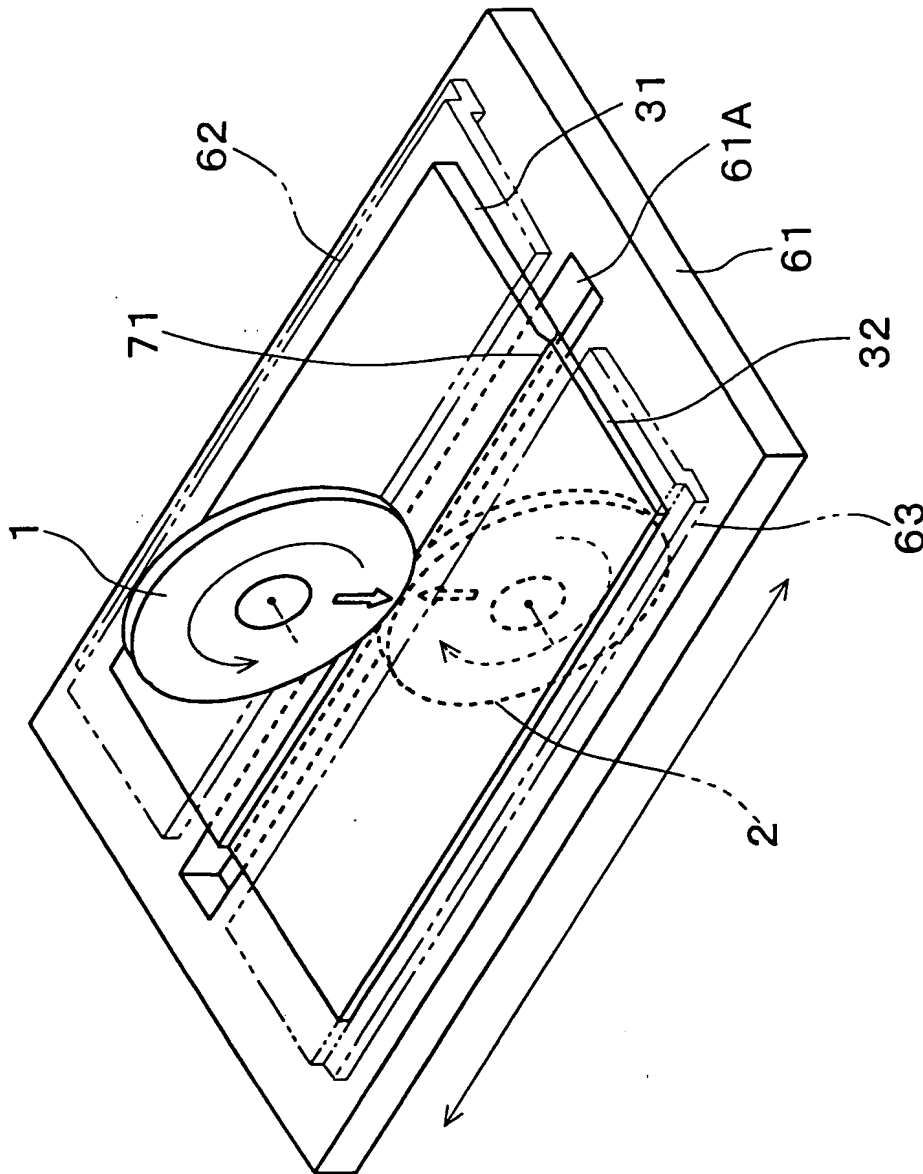
71, 72, 73, 74, 75, 76, 77, 78, 79: butt portion

48: nugget

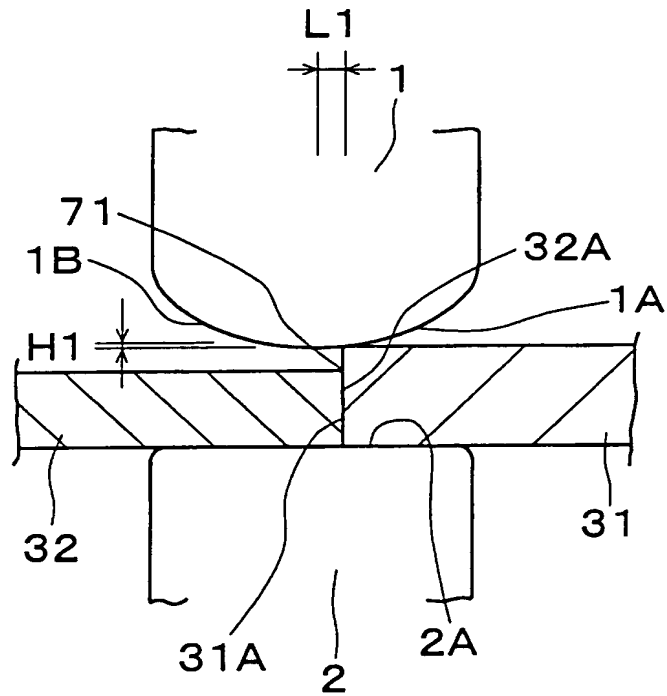
94, 95: press forming die

[NAME OF DOCUMENT] DRAWINGS

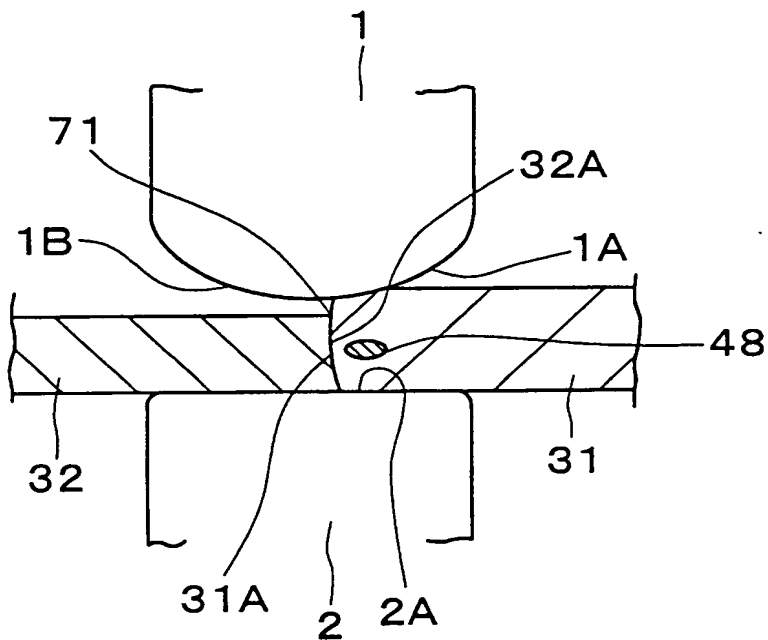
[FIG. 1]



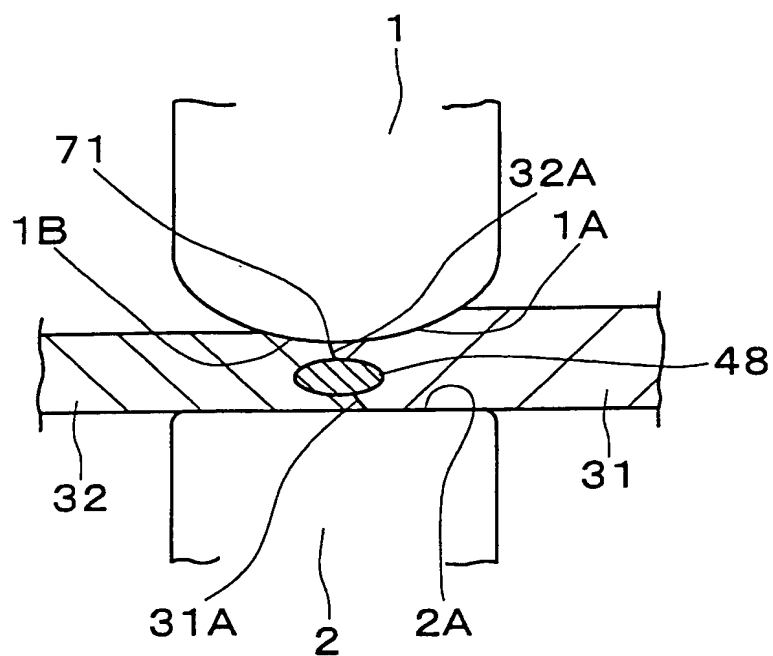
【FIG.2】



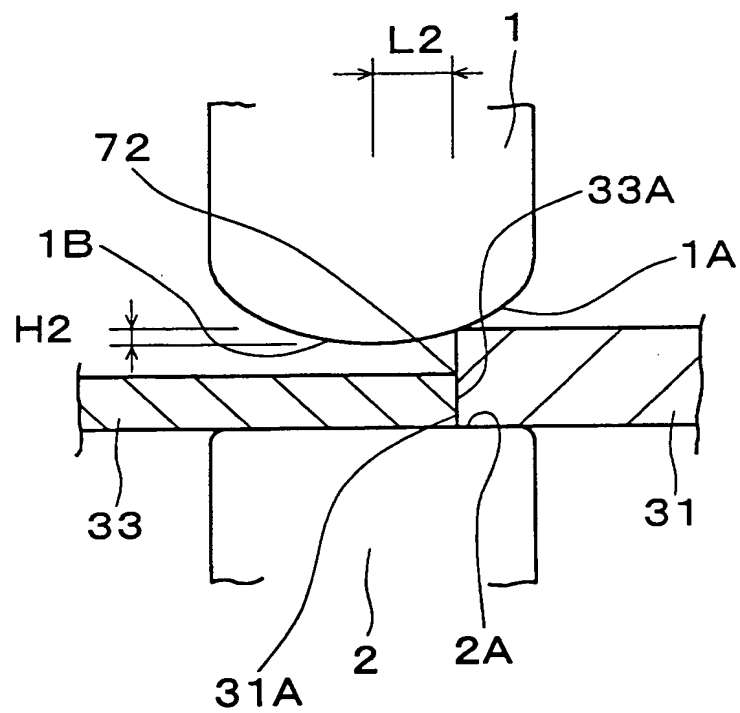
【FIG.3】



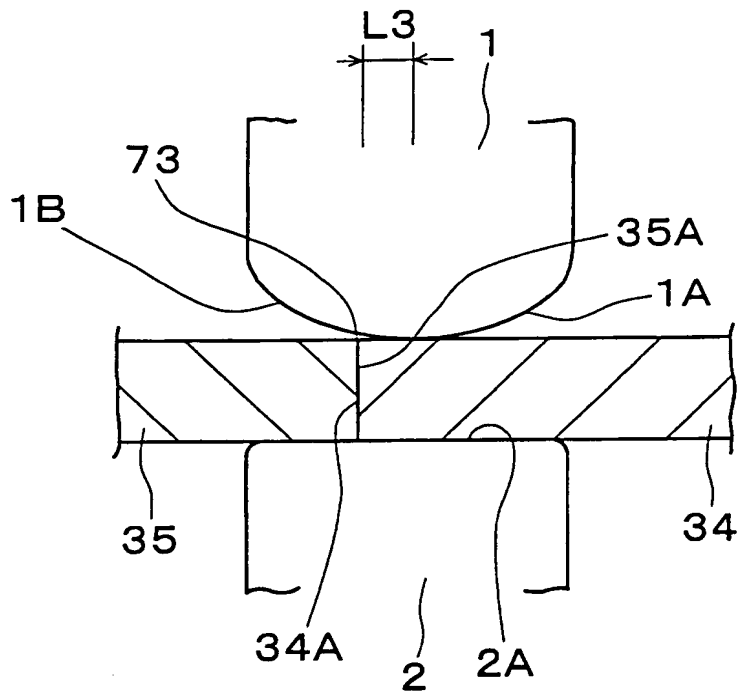
【FIG. 4】



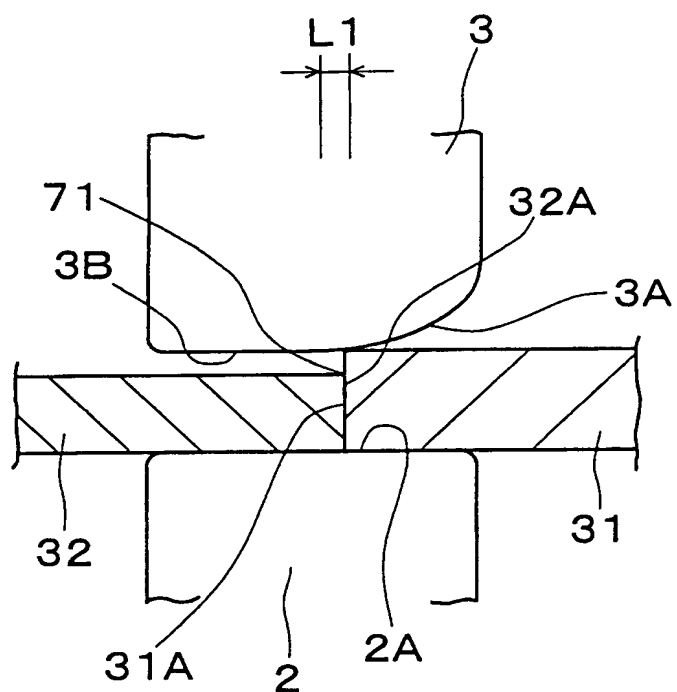
【FIG. 5】



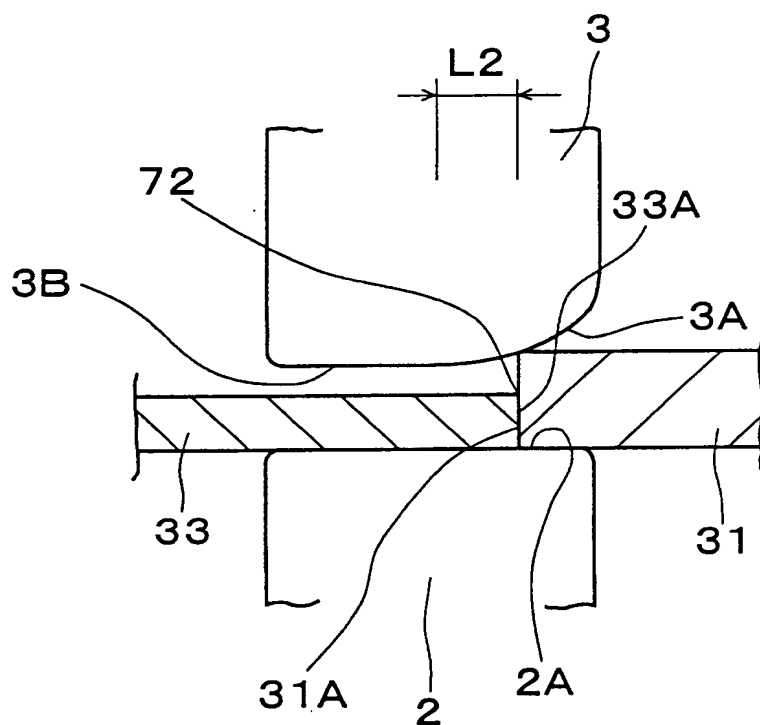
【FIG. 6】



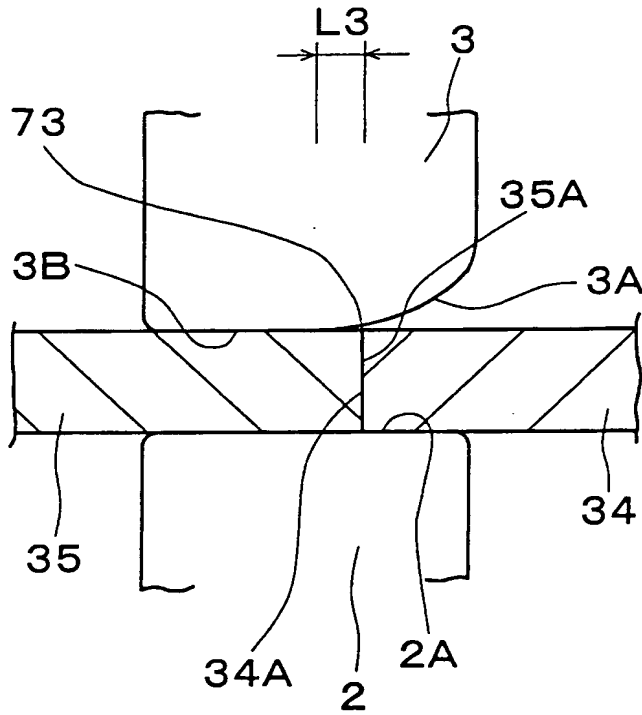
【 F I G. 7】



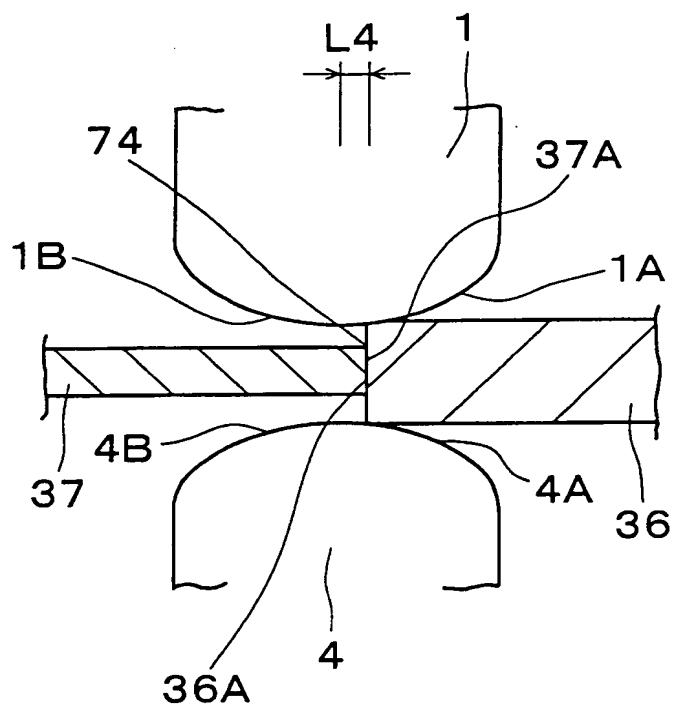
【 F I G. 8】



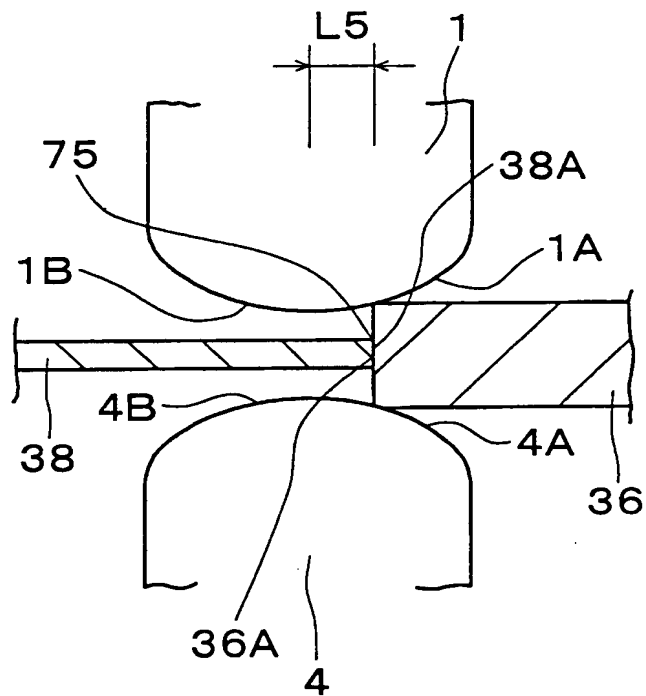
【FIG. 9】



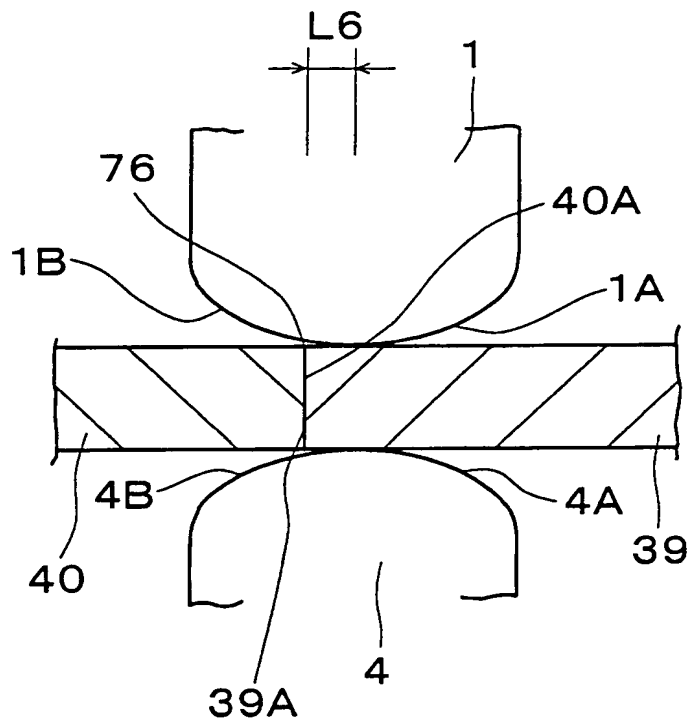
【FIG. 10】



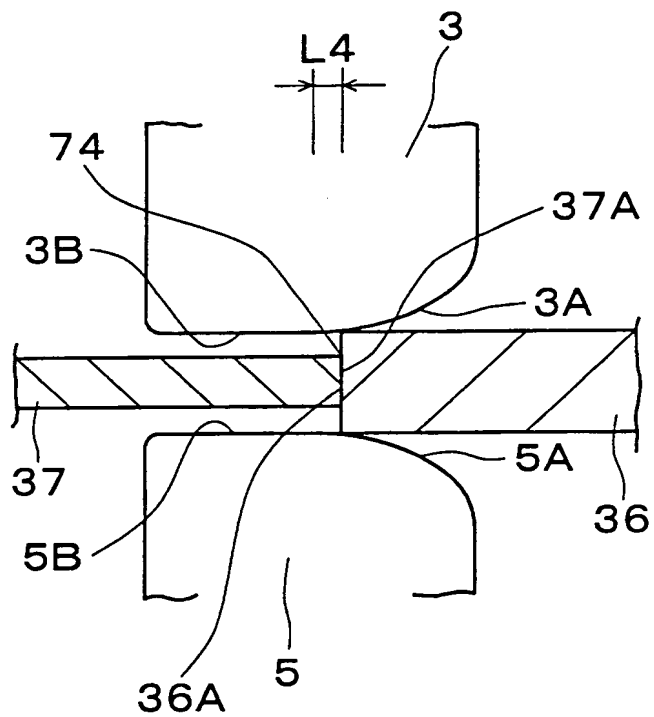
【FIG. 11】



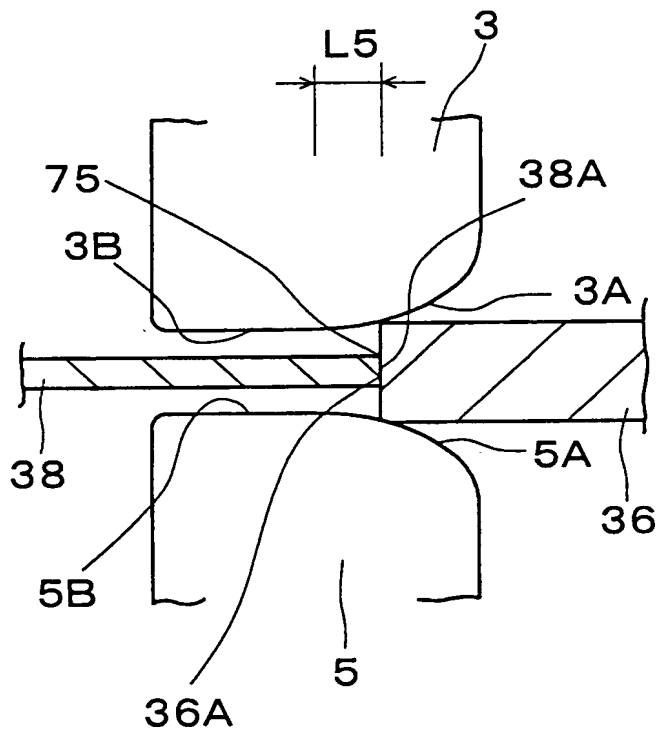
【FIG. 12】



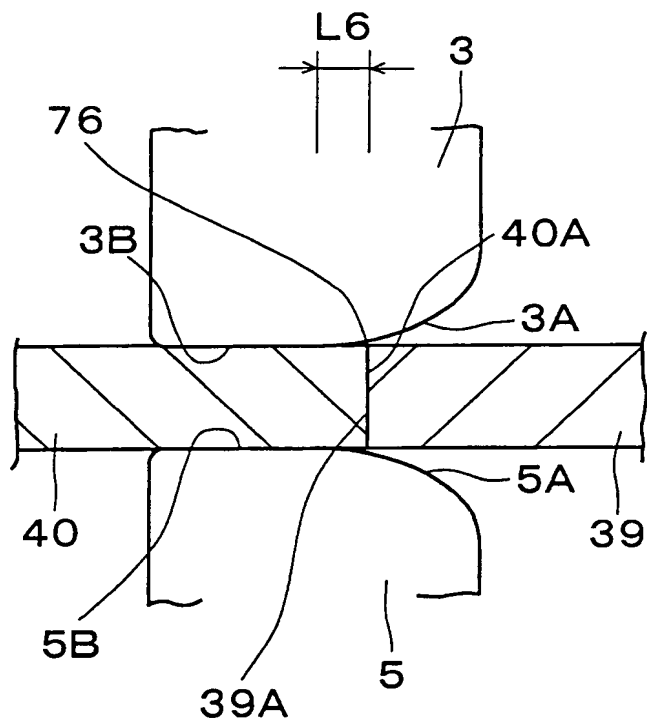
【FIG. 13】



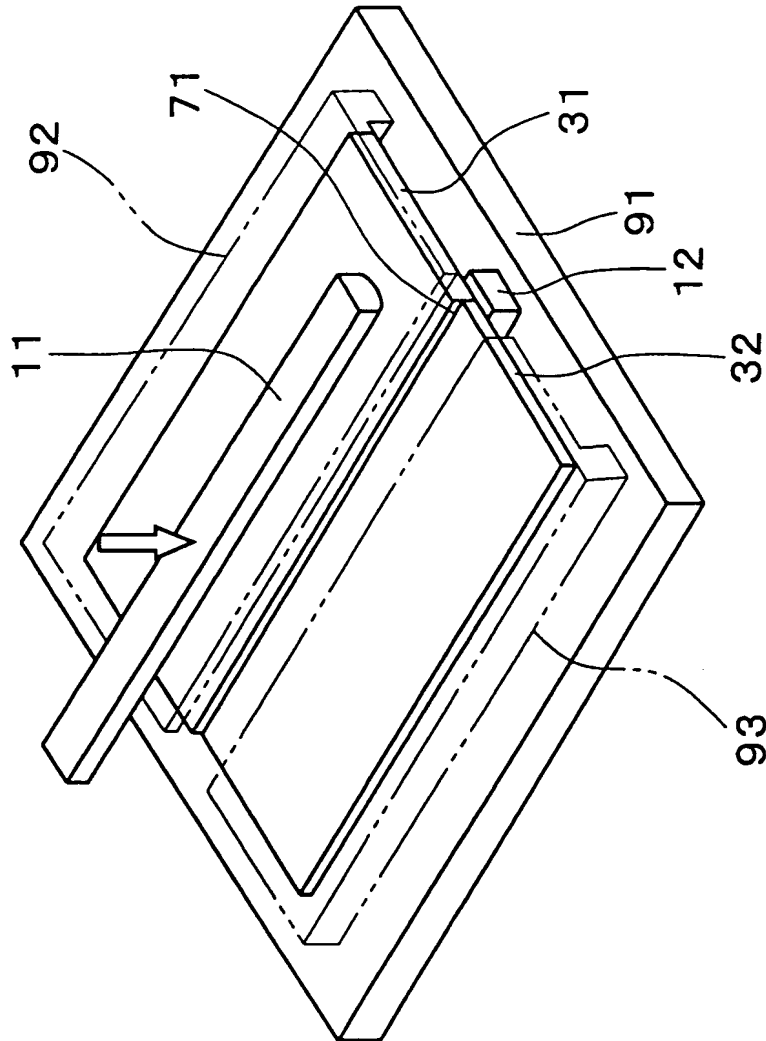
【FIG. 14】



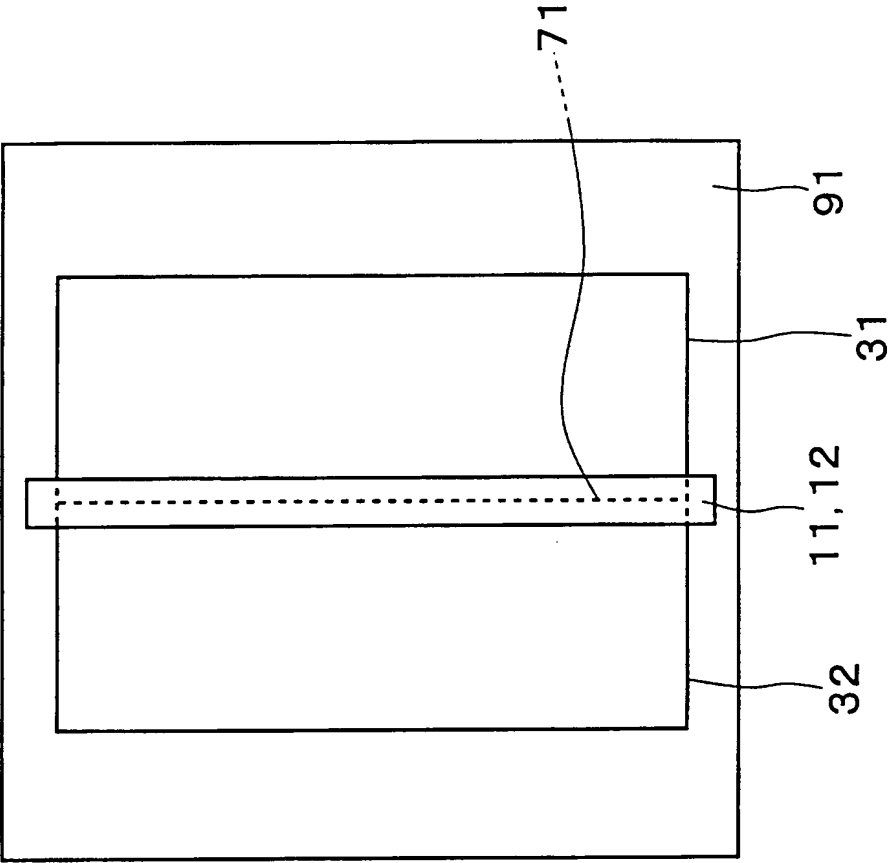
【 F I G. 15】



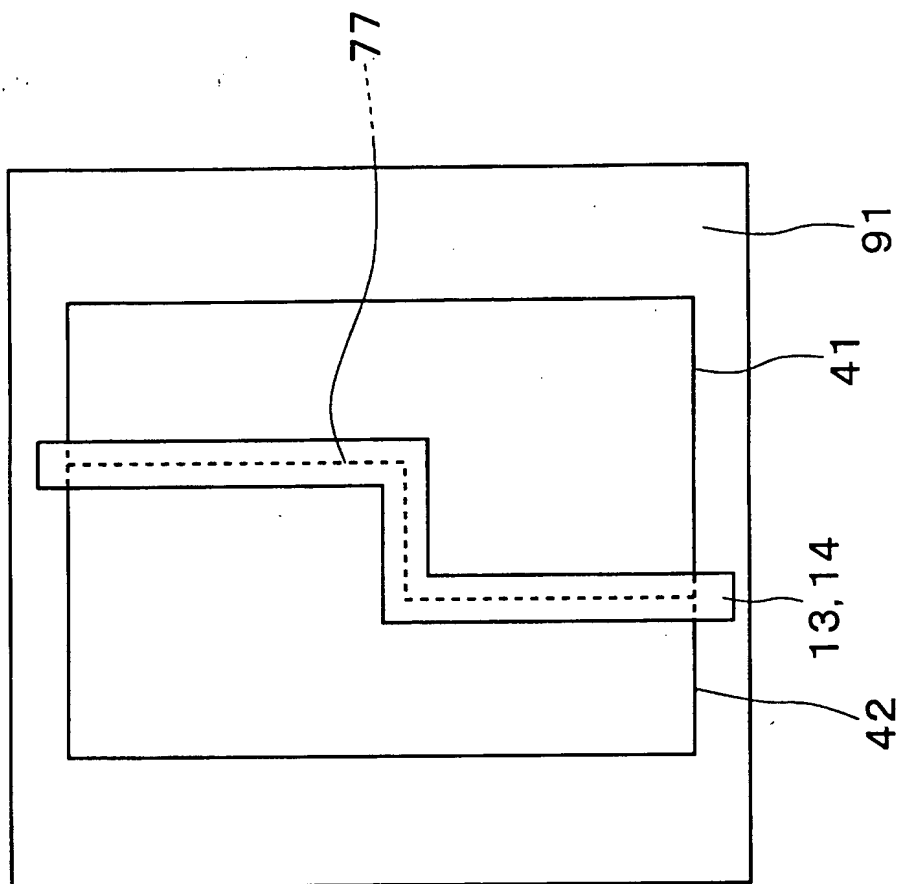
[FIG. 16]



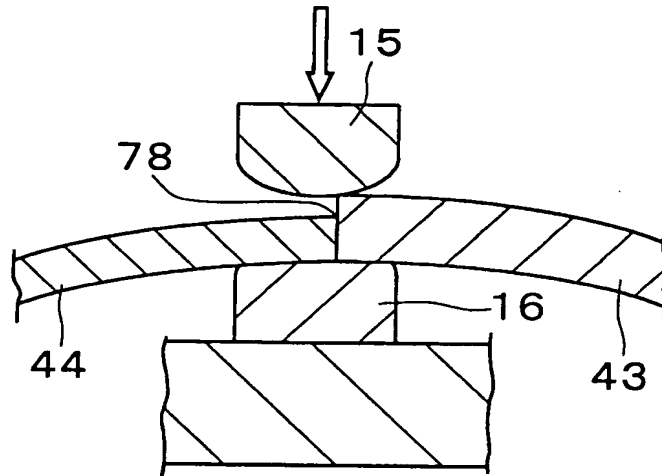
【 F I G. 17】



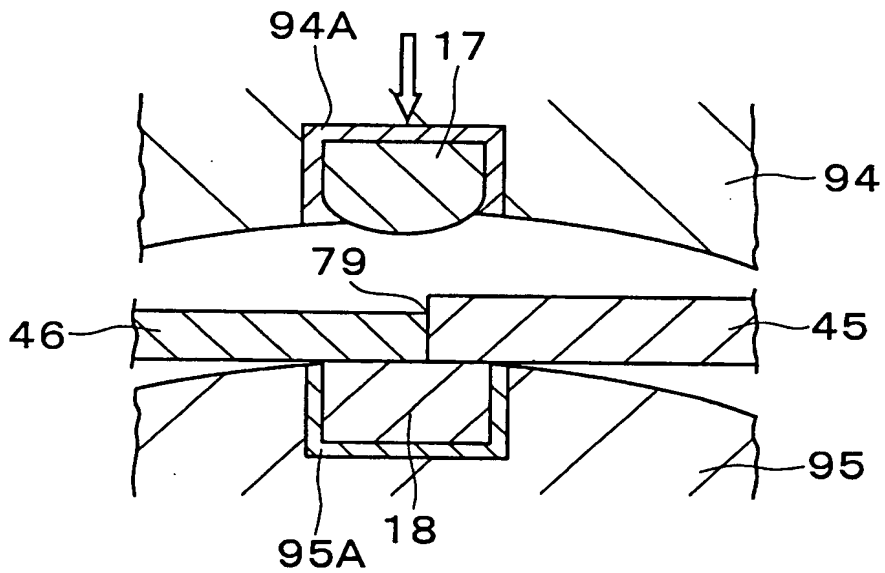
【FIG. 18】



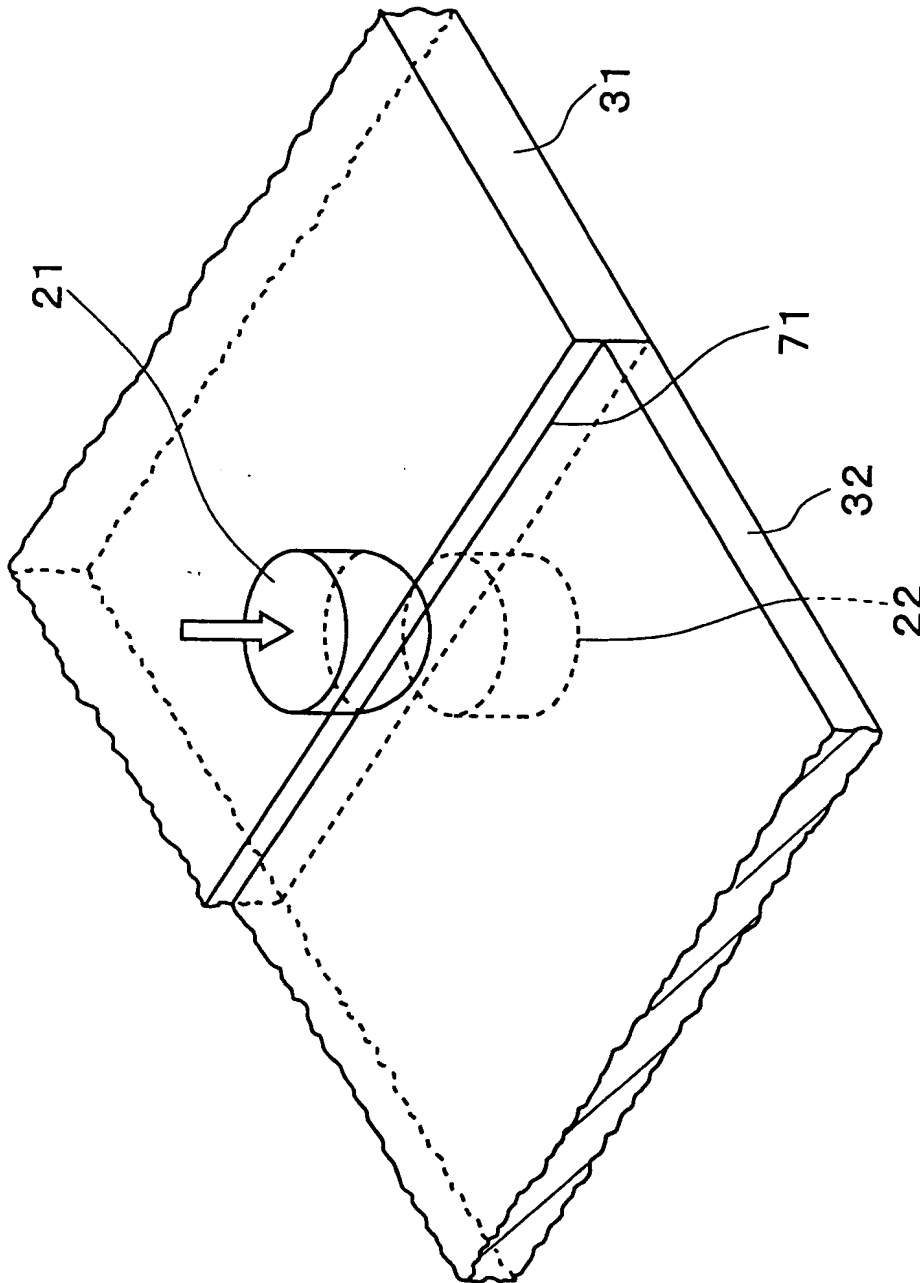
【FIG. 19】



【FIG. 20】



【FIG. 21】



[DOCUMENT NAME] ABSTRACT OF DISCLOSURE

[ABSTRACT]

[OBJECT]

The present invention is to provide a butt welding apparatus where butt welding regarding plate members to be welded having various thickness sizes can be implemented by electrode members made common.

[SOLVING MEANS]

One electrode roller 1 of a pair of electrode rollers 1, 2 for butt-welding two plate members 31, 32 is provided on an outer face of the electrode roller 1 with a retreating-shaped portion 1A which gradually retreats from the plate member 31 according to extension from a central portion, in a thickness direction, of the electrode roller 1 along the plate member 31 and a second retreating-shaped portion 1B which gradually retreats from the plate member 32 according to extension from the central portion, in the thickness direction, of the electrode roller 1 along the plate member 32. Butt welding of the plate members 31, 32 is performed in a state that the position of a butting portion 71 has been offset from the central portions, in thickness directions, of the electrode members 1, 2 by an amount L1, and butt welding of two other plate members having a different difference in thickness is performed with a changed offset amount.

[SELECTED FIGURE] FIG. 2